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DYNAMICS OF KNOWLEDGE TRANSFER IN ORGANIZATIONS:IMPLICATIONS FOR DESIGN OF LESSONS LEARNED SYSTEMS

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This report provides a review and analysis of issues affecting the design of a lessons learned system for defense acquisition professionals. It draws both upon studies of existing lessons learned systems and upon the literature of organizational learning and knowledge management. While the discussion focuses on the enterprise of defense acquisition, the report's conclusions may be extended to lessons learned and knowledge management systems in other areas as well. The exploration of these issues suggests that attention to social processes within organizations is as important, if not more so, as the development of information technology processes in the success of a lessons learned system. The conclusions provide a resource for decision makers in considering and determining appropriate requirements for and resources to support an acquisition lessons

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Abstract

This report provides a review and analysis of issues affecting the design of a lessons learned system for defense acquisition professionals. It draws both upon studies of existing lessons learned systems and upon the literature of organizational learning and knowledge management. While the discussion focuses on the enterprise of defense acquisition, the report's conclusions may be extended to lessons learned and knowledge management systems in other areas as well. The exploration of these issues suggests that attention to social processes within organizations is as important, if not more so, as the development of information technology processes in the success of a lessons learned system. The conclusions provide a resource for decision makers in considering and determining appropriate requirements for and resources to support an acquisition lessons learned system.

I. Introduction

This report provides a review and analysis of issues affecting the design of a lessons learned system for defense acquisition professionals. It draws both upon studies of existing lessons learned systems and upon the literature of organizational learning and knowledge management. Its conclusions provide a resource for decision makers in considering and determining appropriate requirements for and resources to support an acquisition lessons learned system. While the discussion focuses on the enterprise of defense acquisition, the report's conclusions may be extended to lessons learned and knowledge management systems in other areas as well.

The report begins with an overview of organizational learning concepts to establish the intended benefits of lessons learned systems. It then discusses operation and characteristics of existing lessons learned systems, as well as some issues in their use. The report then turns to address in some detail significant issues relating to how organizations learn and how they transfer knowledge among members and subunits. The exploration of these issues suggests that attention to social processes within organizations is as important, if not more so, as the development of information technology processes in the success of a lessons learned system.

II. Background

a. Project History

During a meeting at the Naval Postgraduate School in early 1998, representatives of the Army Acquisition Career Management Office, the Naval Postgraduate School (NPS) Department of Systems Management, and TRADOC Analysis Center-Monterey (TRAC-Monterey) discussed the idea of developing a lessons learned capability for the acquisition community. On 1 May 1998, NPS Assistant Professor K. Snider and Colonel M. McGinnis, then Director of TRAC-Monterey, presented a concept briefing on "Acquisition Lessons Learned" to Mr. Keith Charles (then Deputy Assistant Secretary of the Army for Plans, Programs, and Policy) and members of his staff. Mr. Charles expressed support for the concepts presented and requested further definition of tasks and resources necessary to develop this capability. Prof. Snider subsequently submitted a project proposal reflecting a joint NPS/TRAC-Monterey effort to design and develop, under ACMO sponsorship, a virtual (i.e., internet-based) center for acquisition lessons learned during FY99. TRAC-Monterey received funding to begin work in November 1998. Work on an operational prototype system continued through the end of FY00.

b. Intended Project Benefits - Organizational Learning

The phrase "lessons learned system" in this report refers to the activities, people, and products that support the recording, collection, and dissemination of lessons learned in organizations. These systems may focus on "negative" lessons of failures, deficiencies, and other problems to be avoided, or on "positive" lessons of innovative techniques and "best practices" to be emulated. Definitions of "lessons learned" vary. While the Army

defines them as "validated knowledge and experience derived from observations and historical study of military training, exercises, and combat operations" (U.S. Army, 1997, p. 1), in the Marine Corps they are "procedures developed to 'work around' shortfalls in doctrine, organization, equipment, training and education, and facilities and support" (U.S. Marine Corps, 1994). Most systems in current use are inter- or intranet-based.

Though the idea of learning from experience is timeless, formal organizational systems for capturing and disseminating lessons are relatively new phenomena. Attention to such systems has grown in light of developments in knowledge management (Nonaka, 1991; Davenport & Prusak, 1998), as well as through the popularization of organizational learning concepts such as the "learning organization" (Senge, 1990). This growth is especially evident in the private sector, where a firm's learning capabilities and knowledge are viewed as strategic resources that give it a competitive edge (Davenport, 1997a; Zack, 1999a). Advances in information technology in areas such as intranets, data repositories, and expert systems hold out the promise of wider, more efficient distribution of lessons within an organization.

Contemporary organizational learning concepts reflect the ideas of early twentieth century pragmatists such as John Dewey (1925), who believed that people learn principally from experience. Based on experienced consequences of past actions, individuals develop "habits of action," or implicit theories that guide future actions. The pragmatists saw human experience as continually evolving, and so they rejected the idea of immutable truths or fixed principles. Rather, they held that, since knowledge is obtained through a constant process of encountering and attempting to resolve problematical situations, it has a pluralistic and experimental quality. Learning occurs as habits of action are modified and adjusted to respond to new problems or in light of newly experienced consequences of actions.

Lessons learned systems represent an attempt to extend this view of human learning to means by which an organization may "learn" from its past actions. Of course, the use of phrases such as "organizational learning" and "learning organization" raises issues of reification and anthropomorphism (Lipshitz *et al.*, 1996). Some writers address such issues by defining organizational learning in terms of members learning from each other, that is, when members share "theories of action" (Argyris and Schön, 1978) or "mental models" (Senge, 1990). Many see an organizational culture (Schein, 1985) that promotes such sharing through honest and open communication as a key determinant in the creation of a learning organization (Cook and Yanow, 1993).

Lipshitz *et al.* (1996) take a more structural approach by focusing on organizational mechanisms that facilitate, make explicit, or routinize such sharing. These are "institutionalized structural and procedural arrangements that allow organizations to systematically collect, analyze, store, disseminate, and use information that is relevant to the effectiveness of the organization" (293). Such mechanisms could include organization histories, project reports, after-action reviews (Busby, 1999) and more generally, lessons learned systems. These mechanisms are intended to allow an individual's learning to become recorded in an organization's documents, processes, and other "memory" media

in such a way that other members may learn from it. Lipshitz *et al.* thus see organizational learning occurring when such mechanisms are employed, and the learning organization as one that employs them.

Knowledge management incorporates many organizational learning concepts. Because it is a relatively new field of study, researchers have not yet established rigorous conceptual boundaries between the two. One probably can safely say, however, that organizational learning research stresses organizational processes and thus has a strong "organization development" flavor, while knowledge management research emphasizes managerial processes associated with knowledge creation, elicitation, analysis, storage, and dissemination.

Other organizational learning concepts include single-loop learning, which occurs when members take actions in response to perceived problems or opportunities and evaluate the effects of those actions. Double-loop learning is characterized by a double feedback loop that connects the detection of problems and opportunities not only to corrective actions, but also to an organization's implicit assumptions and underlying norms. Such learning often challenges the *status quo*, and it can lead to fundamental organizational transformations as new norms and assumptions arise.

To summarize, organizational learning concepts explain the intended benefits of lessons learned systems--to contribute to improved effectiveness or to facilitate an organization's adaptation to a changing environment. These occur through the modification of an organization's "habits of action," which might be reflected in changes to informal and tacit routines of operation or in revisions to formal and explicit SOPs, policies, or regulations.

III. Lessons Learned Systems

a. Center for Army Lessons Learned

From the outset, this project was guided by the presumption that acquisition leaders have desired to equip acquisition practitioners with a resource similar to that provided to Army war fighters by the Center for Army Lessons Learned (CALL) at Fort Leavenworth, KS. Established in 1985 for the purpose of collecting lessons learned during simulated combat training exercises (U.S. Army, 1997), CALL is the earliest and best-known lessons learned system. Over the years, its mission has expanded to encompass lessons from actual combat and other military operations (e.g., JUST CAUSE in 1989). CALL's methods include both active collection of lessons by dedicated expert observer teams as well as passive collection of lessons submitted from the field. CALL is staffed with resources necessary to accomplish a variety of lessons learned functions, including collection, analysis, processing, dissemination, archiving, and research. It publishes tailored lessons learned products in a wide variety of media, including newsletters, handbooks, bulletins, and the internet, including both secure and public on-line databases.

b. System Characteristics

Zack (1999a, 48-49) describes the general sequence of operation of a lessons learned system. First a lesson is generated, usually by the individual learning the lesson or by an observer. The lesson is then submitted to the lessons learned system for processing, the extent of which is discussed below. It is then made available to other members of the organization, whether through publication and dissemination, or by storing it for later retrieval.

While lessons learned systems have the same general objective, they differ widely in aspects of design and operation. Table 1 adapts Aha's (2000) characterization, developed from an analysis of existing lessons learned systems, to group system characteristics into lesson, operational, and organizational factors.

Lesson factors describe the "product" of the system, that is, whether it produces lessons only (pure) or includes other products such as best practices or information updates (hybrid). The other lesson factor describes the type(s) of processes addressed by the lesson or other product. Technical processes usually deal with scientific, engineering, or other highly technical matters. Administrative processes usually involve fairly routine procedures or decisions made by a single individual, for example, a purchasing specialist. Planning processes entail more complex and strategic matters involving multiple stakeholders. CALL, for example, focuses mainly on "tactics, techniques, and procedures" for operational forces rather than on "macro-issues" or strategic operations; hence its processes would be classified as "technical."

Lesson:				
	Content	Pure		Hybrid
	Process Type	Technical	Administrative	Planning
Operational:				
	Access	Open		Closed
	Formality	Formal		Ad Hoc
	Locus	Centralized		Distributed
	Process Relation	Embedded		Standalone
	Acquisition	Active		Passive
	Handling	Rigorous		Open
	Dissemination	Active		Passive
Organizational:				
	Interpretive Context	High	Medium	Low
	Type	Adaptable		Rigid

Table 1. Lessons Learned System Characteristics (adapted from Aha (2000))

Operational factors describe how lessons learned system function. Access refers to the extent to which those outside an organization may use its system. Open systems may be accessible to the general public, while closed systems have security features that limit their use to members of the organization. Formal systems have established procedures and processes of operation, such as those described in CALL above. The U.S. Geological Survey has taken a more informal approach in generating lessons that are based on analysis and synthesis of the findings of more than 250 scientific studies of the environment. These assist local natural resource managers in policy and decision-making (U.S. Geological Survey, 1995). Another example of an informal system is the Navy Acquisition Reform Office's (ARO) "Change Through Ex-Change" Initiative. Every three months, ARO solicits acquisition organizations to provide two approaches, ideas, process innovations, or lessons learned. These are distributed via diskette and are posted on the ARO web site. At an annual conference hosted by ARO, participants discuss their ideas and are encouraged to embrace two new ideas by incorporating them into their own offices or programs (U.S. Navy, 1999).

CALL is an example of a centralized lessons learned system that serves the Army worldwide from its offices at Fort Leavenworth, Kansas. The Department of Energy (DoE) operates a distributed system with a networked infrastructure of systems and lessons learned "coordinators" at various sites and contractor facilities. Lessons learned systems are embedded if they operate in an integrated fashion during other organizational activities, as in the case of Army units conducting after-action reviews in the course of training exercises (Baird *et al.*, 1999). Embedded systems usually feature active acquisition and dissemination ("pull" and "push") of lessons, while standalone systems "wait" for user input and retrieval of lessons. The U.S. Marine Corps Lessons Learned System (MCLLS) relies heavily on decentralized reporting (i.e., passive acquisition) from unit after-action reports of exercises and operations.

Handling refers to the level of treatment a lessons learned system gives a lesson after it has been generated. Rigorous handling implies significant control through some review and approval process, while open handling implies little or no control of lessons. At bottom, handling involves decisions as to whether one individual's learning, as reflected in the lesson, should be shared with others. Questions that arise here may include: Does the information in the lesson need to be verified, substantiated, or validated? Is additional information or discussion necessary to make it understandable to others? Does it sufficiently describe context and circumstances so that other members of the organization can judge the lesson's relevance under differing conditions? Is it consistent with organizational goals and policies? For example, CALL includes in its process of lesson development a coordination step to solicit comments from agencies and commands that may be affected by or have interest in dissemination of a lesson. The MCLLS features a process of lessons learned reviews by various working groups and committees, which assign responsibilities for analysis, action, and disposition. DoE lessons learned coordinators, among their other duties, perform a validation function before a lesson is submitted for publication.

Two organizational factors may be considered when determining how handling should occur. Interpretive context (Zack, 1999a, 50) refers to the extent to which members of an organization share similar knowledge, backgrounds, and experiences. In an organization with a high interpretive context, most members are likely to understand the content and significance of lessons generated by other members. Lessons generated in an organization with a low interpretive context may need to include more detail in terms of description and explanation, and may need to be "translated" during handling for broader understanding. The other organizational factor to be considered is how rigid or adaptable an organization is in terms of changing its "habits of action" in response to lessons learned by its members. An organization may have a culture that inhibits its ability to change, or it may be constrained by laws, professional standards, or by other organizations. Such constraints indicate the potential need to review, validate, and perform coordination on lessons before they are disseminated to and shared with the rest of the organization.

c. Lessons Learned System Issues

Though the benefits of lessons learned systems, and more generally, knowledge management systems have been widely touted (Davenport, 1997a; Zack, 1999b), success is not guaranteed. One of the most significant pitfalls, according to Davenport (1997b), is the "If you build it, they will come" fallacy. That is, merely implementing a lessons learned system doesn't ensure that members of an organization will use it, either to generate lessons or to seek out those learned by others. Reasons for such lack of use are usually attributable to issues of motivation or organizational culture. Individuals may simply not have time to generate lessons after a learning experience, or perhaps they feel unwilling to acknowledge that problems have occurred. Others who are facing new situations may be unwilling to seek out lessons learned by others if they feel their problem is unique and not amenable to solution by past methods. Such participation issues may be addressed through a "championing" of the system by the organization's leaders or through rewards and incentives designed to institutionalize use of the system (Fulmer, 1999).

The effectiveness of a lessons learned system might also be affected by the substance of lessons, particularly if handling is not rigorous. Individuals may generate lessons containing problematic information such as unsubstantiated opinions, controversial findings, or self-serving claims, to name but a few. They may be poorly written, perhaps with little background or context that would allow others to judge its wider application, or with too much detail that bores or confuses readers. Such problems point out the need for some degree of rigor in handling.

Of course, too much rigor in handling may squelch participation. Processes of review, editing, validation, and approval may become so burdensome that organizational members may lose interest in submitting lessons. This indicates the need for a lessons learned system to include some feedback mechanism so that those involved in handling can keep members apprised of the status of their submissions.

Finally, LLS require maintenance. For example, databases need to be reviewed for outdated content, and periodic upgrades may be needed to incorporate new technology. Of course, such maintenance requires resources, which means that LLS must "compete" with other organizational programs for scarce resources. The failure of leaders to provide adequate resources may be perceived as a lack of organizational commitment, leading to low participation levels.

d. Summary

The discussion above has illustrated a range of alternatives available to designers of LLS. This range indicates the need to examine several different factors of an organization and its knowledge needs in order to arrive at a system design that fits the organization well.

To this point this report has treated knowledge, as embodied in lessons learned, in an implicitly sterile, individualistic, and mechanistic way. That is, it has portrayed knowledge as a commodity that may be obtained or developed by an individual and subsequently transferred to others. Such treatment ignores, however, significant epistemological issues. For example, against the commodity view of knowledge is the idea of knowledge as socially constructed (Berger and Luckman, 1967), or put another way, as the product of interpersonal relationships. The constructivist perspective emphasizes social processes that lead to knowledge creation and sharing. Drawing this distinction has profound implications for the design of a lessons learned system. From the commodity perspective, one would probably design the system to emphasize the ease of lesson input and extraction by organization members, while from the constructivist view, one would design to enhance development of their interpersonal relationships. The authors see such issues as too important to ignore and turn now to explore them in detail.

IV. Organizational Learning in Acquisition

a. Framing the Problem

The challenge of creating a system in which acquisition professionals can learn from one another raises a more general question that has been explored in the literature – namely, the question of how organizations learn, and more specifically how subunits transfer knowledge. The literature of knowledge management suggests in fact that the transfer of horizontal knowledge in organizations, especially when the incentives for doing so are not clear, is the major challenge for postindustrial organizations.

Defense acquisition presents particular challenges. It is a relatively new area of study with few conceptual foundations upon which to build. Acquisition is a highly complex enterprise that encompasses multiple contexts—those of politics, business, technology, and the military, to name a few—and multiple stakeholders with often competing interests (Fox, 1988; McNaugher 1989). It also has a highly interdisciplinary

character in that its practice requires integration of a broad range of technical and management skills, including contracting, system engineering, finance, and many others.

Acquisition managers are knowledge specialists, in that they have unique experiences in solving specialized kinds of problems, overcoming distinct barriers, forming alliances, developing cooperative relationships, working on common problems. In a sense, they master a complex kind of knowledge in which they must improvise solutions to new kinds of challenges for which procedural knowledge offers limited guidance. In some ways, the challenges of coordinating the diverse groups and interests in order to accomplish successful acquisition is unprecedented and shows no signs of getting simpler. There are few existing models to serve as guides.

Sometimes organizations seek to improve learning by focusing on outcomes without attending to the processes that led to these outcomes (Brown and Duguid, 2000). This is often reflected in efforts to improve organizational effectiveness, such as total quality initiatives and reengineering, which are outcome-based interventions. To improve the acquisition process, however, it is not enough to study and learn about outcomes. One must understand the inner workings of the process, the practices and the meanings they have for those involved. In order for a "lessons learned" project to be successful, it is important to learn about members' practices. As Brown and Duguid (1989) point out, "people regularly invent ways around difficulties, discontinuities and unexpected irregularities in the course of their daily work and learn about their work in the process." Local innovations seed new possibilities, new ways of framing things, and new horizons of actions.

In studying actors' practices, it is important to acknowledge that there are tensions within practices and that these tensions are often about struggles over meaning. This tension shows up most clearly when there is some organizational pressure for uniform information over the practice-based struggle for locally coherent meaning. It is important to allow for a diversity of practices and meanings and not squelch these local experiments in hopes of a uniform outcome. This raises the question of how organizations manage the learning process. Although organizations are primarily hierarchical, the development, dissemination, and use of knowledge is horizontal; knowledge often resists efforts aimed at direct control and manipulation. What are needed are processes that encourage the flow and transfer of knowledge as well as an infrastructure within which the creation of knowledge can occur.

Improving the acquisition process involves acknowledging the unique kind of knowledge necessary to be successful at this task. The acquisition process is complex in that it is idiosyncratic (different parties improvise different solutions to unique challenges) and contextual (different projects and schedules pose different kinds of challenges). In addition, the acquisition process is becoming increasingly critical and sensitive in the sense that it involves essential missions for which failure cannot be tolerated. Some new systems and subsystems, such as space or information technology systems, have no precedent. Thus, it is unlikely that the acquisition process will improve by trying to routinize each of its components. Congressional efforts to dictate

management improvements have met with mixed results and perhaps have made the process more cumbersome. A successful "lessons learned" project must involve appreciating (and sharing) the actual practices of managers during each stage of the acquisition process.

To address this issue, this section of the report searches literature to address a number of themes, including: the various kinds of knowledge, the conditions that support and inhibit the transfer of knowledge between organizational subunits, the various forms that represent different knowledge, the transfer of knowledge within virtual communities. This last theme addresses important questions at the heart of the success of a lessons learned project. It is important to look at the relationship between information technology and knowledge management. Many assume that knowledge management cannot be done without technology. However, there is an important corollary: building elegant information systems will not guarantee participation nor will it guarantee learning. These questions are important because there is a popular myth in management circles and in some organizational literature, that knowledge is a matter of sharing information or that knowledge is simply a matter of acquiring information about a problem. This ignores evidence that organizational productivity has not improved in spite of large investments in computer technology, what Brown and Duguid have called the "productivity paradox" (2000, p. 83).

b. Knowledge Complexity and Interdependence

With the advent of advanced information systems, many organizations have increased information distribution and access with the hopes that learning will increase. Traditional views of knowledge and learning equate knowledge with information, as something that can be codified and shared. The assumption here is that knowledge is absolute, abstract, and context-free. Indeed, most definitions of knowledge management define the core problem in terms of information, thus putting the solution in the hands of information technologists. The notion is that making information available stimulates search processes. However, there is another field of knowledge management emerging that contends in order to understand how "best practices" travel, requires looking not simply at information, but how knowledge emerges in practices among groups of practitioners. More recently, studies have begun to appreciate that much of what we take to be knowledge is "know how" that is contextual and is something that people "do" *in situ*. These themes are reviewed below.

Theorists of knowledge management have distinguished between different kinds of knowledge. The type of knowledge to be transferred influences what should be the best method of transfer. Consider the difference between learning how to do an algebra problem and learning to be a carpenter. One can be understood via the transmission of abstract concepts; learning to be a carpenter, however, involves purposeful activity and experimentation, a kind of learning that is beyond verbalization. Many (e.g., Nonaka, 1991) have built on the work of Polanyi (1966) to create a distinction and a continuum between explicit and tacit knowledge. Knowledge that is considered complex, difficult to verbalize, codify or document in writing is tacit knowledge; it can be acquired only

through experience. Tacit knowledge is highly personal and deeply rooted in action. It also has an important cognitive dimension and consists of mental models, beliefs, and perspectives so ingrained that we take them for granted and cannot easily articulate them. Explicit knowledge is that which can be codified, is acontextual and corresponds to traditional "banking concepts" of learning in which we assume knowledge can be transferred from one party to another regardless of context. Not surprisingly, most studies agree that knowledge that can be codified is easier to transfer than complex knowledge.

Hansen (1999) describes knowledge dependency. Knowledge that is independent (for example, a stand alone, distinct software module) and does not rely on other knowledge components is easier to transfer than knowledge that is dependent on and must function in conjunction with other components. When knowledge to be transferred is complex and interdependent, knowledge transfer is difficult.

Tyre and Hippel (1997) emphasize the situated nature of knowledge. They claim that knowledge is not absolute, but is dependent on context and setting. Actors no doubt draw upon codified, abstract theory in their local, informal routines, but they adapt them as they work on problems within particular circumstances. Looking at the "situated" nature of learning has led knowledge management theorists to discern the complexity of knowledge to be transferred and raises the issue of knowledge representation. Often organizations fail to recognize the complexity of knowledge by listing jobs in simple, canonical steps, perhaps in an effort to "downskill" positions. When managers and designers adopt this outlook, it inhibits their comprehension of the importance of non-canonical practices. From this perspective, people look like they are performing jobs according to formal job descriptions. Actual on the job practice, however requires interpolations between abstract knowledge and practical, situated demands.

Orr (1996) points out the dichotomy between managers' understanding of job requirements and actual practices: "Although the documentation becomes more prescriptive and ostensibly more simple, in actuality the task becomes more improvisational and more complex" (p. 42). This point is illustrated in his study of Xerox's training of service technician representatives. The trainers, in an effort to downskill the task of machine repair, attempted to document every imaginable breakdown in copiers, so that when technicians arrived to repair a machine, they simply looked it up in the manual and followed a pre-determined decision tree to perform a series of tests that dictate a repair procedure. Their premise was that a diagnostic sequence could be devised to respond to the machine's predictable problems. However, the study revealed that no amount of documentation could include enough contextual information necessary to understand every problem. Orr relays a story of a technical representative confronting a machine with error codes and malfunctions that were not congruent with the diagnostic blueprint. This machine's malfunction did not fit the kind of errors that were documented nor had anything like this problem been covered in his training. Both he and the technical specialist he called in to help were baffled. To simply give up the repair effort and replace the machine would have been a solution, but would have meant loss of face with the customer - an unacceptable solution. After exhausting the approaches suggested by the diagnostic, they attempted to make sense of this anomaly

by connecting it to previous experiences and stories they had heard from others' experience. After a 5-hour trouble shooting session of trials and errors, they fell upon a solution.

Many jobs in organizations require this type of *bricolage* - fumbling around, experimenting, and patching together an understanding of problems from bits and pieces of experience, improvising with the materials at hand. Few problems provide their own definitive solutions. In Orr's account, the technicians go through constructing a coherent account of malfunction out of the incoherence of the data and documentation. They go through a long story-telling procedure, talking about the machine's erratic behavior, their memories of other technicians' stories, information from users, which they try to put together in a composite story. The process of forming the story actually becomes an integral part of the diagnosis. This process begins and ends with communal understandings that are not available on canonical documents; narration is an important in integrating the various facts of situation.

This suggests that, in order for knowledge to be transferred, there must be informal interaction between individuals and units. The organization cannot simply decree knowledge transfer and expect it to occur. Informal communication must be encouraged through enabling systems that appreciate the situated context. Tyre and Hippel (1997), in studies of engineers, demonstrated that physical setting is an important part of the learning process. Engineers had to travel back to the lab or to the plant to discover the clues embedded in their context in order to notice the problems that others did not "see." Data gathering is, they claimed, a situated skill. The interpretation of a message depends on where the hearer is located; engineers are able to believe "impossible" sounding problems only when they arrive on the scene and discover the unexpected maintenance problems and how an anomalous event could actually occur. Codified, abstract knowledge is seldom sufficient to solve actual problems in organizations (Tyre and Hippel, 1997). Members must engage in informal, unstructured processes of sensemaking (Weick, 1979) and storytelling (Orr, 1990; Brown and Duguid, 1991). Collaborative inquiry in which ideas grow out of conversations among participants is more useful than classroom learning. Discussion, negotiation, and argument are core to the learning process.

These studies have led Brown and Duguid (1991) to refer to organizations as communities of practices. To foster learning, they contend, organizations must see beyond conventional, canonical job descriptions and recognize the rich practices themselves. In the example of the technical representative above, the successful experience with the recalcitrant machine became part of the technicians' folklore, told and retold during coffee breaks. These stories form a community memory that others could draw upon when facing unfamiliar problems.

What about someone who is simply informally listening to a discussion between two technicians, but is not himself engaged in a legitimized organizational activity? Lave and Wenger (1991) contend that understanding how to function as an insider is essential to organizational learning. This recognizes that learning is much more than receiving

abstract, acontextual, and disembodied knowledge. It is a matter of learning how to speak the language of the community of practitioners. Lave and Wenger adopted the term "legitimate peripheral participation" to describe the dynamics by which someone on the periphery of a community of practitioners can legitimately become socialized into values, norms, beliefs, modes of sense making – all of which are central to the learning process. As members become increasingly socialized into practice they move from peripheral to "full" participation. To participate in a practice community means to have access to "a wide range of ongoing activity, old-timers, and other members of the community; and to information, resources, and opportunities for participation" (pp. 100-101). Members learn new discourses and new ways of talking. By telling different stories, they are constructing meaning about their past and shaping future practice; they are also constructing an identity for themselves and how they are situated within the community. Newcomers learn "to talk as a key to legitimate peripheral participation" (p. 109). Learning is thus more than a matter of the cognitive acquisition of information. It also involves a shift in identity and modes of practice, learning a new way of talking, a new way of sense making, of shaping meaning of past actions and future possibilities; it involves changes in relationships with other members inside and outside the community.

Weick and Roberts (1993), in their study of aircraft carrier operations, developed the notion of "collective mind" and addressed the issue of how a community of practice can create "heedful interrelating." The dynamics of collective mind involve three processes that make up an activity system: contributing, representing, and subordinating. Collective mind exists when individuals construct their activity (contribution), as they envision the activity system (representation), and interrelate actively within the system they envisage (subordination). They acknowledge the power of narrative to capture the rich complexity and nuances of workplace life. This is especially important for socializing newcomers. As new members hear the organization's story and myths, they begin to comprehend what heedful relating means in practice.

c. Relationships Between Learners

If informal networks are important, what kinds of relationships enhance learning? How much mutual trust and understanding is necessary between parties? Following Lucas and Ogilvie (1999), group heterogeneity is an important factor in the dissemination of knowledge. Homogenous groups usually have access to the same information and therefore offer limited opportunities for learning. Potential for knowledge transfer is increased when members have different backgrounds and different experiences. Members can complement each other's understanding when they bring different experiences. However, there is a price for this richer learning potential: it is costly to maintain knowledge transfer among groups that do not have common experiences. Further, it offers the potential for more conflict. This is an important issue, especially if the organization is relying on virtual mode of transfer rather than face-to-face communication.

According to social network theory, knowledge transfer works best when members have weak ties. Granovetter (1982) claims that distant and infrequent

relationships (weak ties) are efficient for knowledge sharing because they provide access to novel information by bridging disconnected groups. Strong ties, on the other hand, are likely to lead to redundant information because they are present in small groups where everyone knows what the others know.

Hansen (1999) argues, however, that network theory is focused on the search for knowledge and access to new information, which overlooks the issue of complex knowledge transfer. Weak ties, he claims, speed up the processing of knowledge when it is not complex, but slow it down when knowledge is more complex. He cites the product innovation literature to demonstrate that close and frequent interaction between teams and subunits leads to project effectiveness because of timely integration of knowledge across boundaries. Members have opportunities for reciprocal interactions, to try out knowledge, and to seek assistance and feedback when the relationship is strongly tied. This raises the issue of temporary relationships, the kind that one is likely to experience in virtual interactions. Hansen claims that it takes time to turn weak ties into temporary strong ties. Relationships to relevant people in another subunit need to be cultivated, and "the source unit's rational for becoming extensively involved in the relationship must be established" (p. 89).

Hansen documents the difficulty of transfer of tacit knowledge. With tacit, complex knowledge, weak ties do not have beneficial effects. "[T]ransferring noncodified and dependent knowledge is less difficult to the extent that the parties to the transfer understand each other" (p. 88). If members are strongly tied, they probably developed a heuristic for processing tacit knowledge. The advantage of weak ties, he claims, is that because members are not tightly linked, they are more likely to search for non-redundant knowledge and are more adaptive because they are less constrained by the organizational system of which they are a part. Strong ties might constrain action while weak ties tend not to threaten autonomy. The disadvantage of weak ties is that there are fewer interactions for transferring complex knowledge; also the knowledge source may be unavailable if problems or questions should arise.

d. Adaptation of Information Technology Systems to Improve Knowledge Transfer: Two Case Studies

This leads to an essential question regarding knowledge management systems: is it possible to create a community of practice when members' connections are virtual, when the mode of interaction is web-based rather than face to face? Many organizations in the past decade have adopted information systems in attempts to enable knowledge transfer.

What are some of the dimensions of the challenge that need to be anticipated and managed? Virtual communities lack the synchronic feedback and reciprocal exchange characteristic of a discourse that creates and reflects a shared history. Transfer of tacit knowledge requires a great deal of face-to-face contact through meetings,

apprenticeships, and training sessions. If a company tries to use a weak link such as an intranet database to exchange complex, tacit knowledge, it will likely fail. Electronic connections are fast but don't allow interaction and interpretation. Trying to exchange explicit information through a strong link is also unsuccessful– explicit information requires the ability to search quickly in a lot of places. The exchange of explicit knowledge can be completed through electronic means; where knowledge is explicit, weak links will do. E-mail is ideal, but strong links, such as meetings, are not efficient. The implications are great for productivity. Where units were exchanging explicit knowledge, those with weak links (e-mail) completed their projects 25 percent faster than those with strong links. Where tacit knowledge was exchanged, however, units with weak links were at a disadvantage; they took 20 percent longer to complete projects than did units with strong links (Hansen, 1999).

There are few empirical studies that actually document the enablers and constraints in the adoption of information systems for this purpose. Most of the literature is anecdotal and prescriptive. However, there are lessons to be learned in the areas of information technology adoption when organizations attempt to share best practices virtually. Two contrasting studies illustrate some of the issues that arise when organizations attempt to implement "lessons learned" through the adoption of groupware systems.

Orlikowski (1993) studied an accounting firm, Alpha Consulting, which adopted and used computerized documentary systems. Alpha Consulting invested in Lotus Notes, a documentary support system that has internet-like capacity with bulletin boards, posting mechanisms, discussion groups, and electronic mail for organizations. Alpha Consulting bought 10,000 copies of the program, believed that it was such a powerful technology that its usefulness would be evident and that if it were rolled out, people would use it. They believed that once people were given the opportunity to use it, they would learn it and find creative applications.

The consultants were spread in different offices across North America and the Director of information technology was concerned that these consultants were working on similar problems but not sharing their expertise with one another. They had hoped that Lotus notes would be a computerized info system that would store and share the solutions consultants had found to a variety of problems, a kind of "best practices" and "lessons learned" program. In the first test of Notes, information technology staff and the tax consultants using Notes found it interesting in their projects. They used the program frequently and extensively. The senior line consultants were modest users while the more numerous junior line consultants were low users. They seemed uninterested in learning how to use the program, and gave up easily when faced with frustrations with Notes. Orlikowski discovered that the younger consultants, the ones targeted for these applications, had less incentive to learn to use the program. Their promotions, and ultimately their careers, are based upon billable hours that are tied to client work. There was no way they could justify billing clients for the considerable time it took them to learn this new system. Also, it was not clear what they would do with Notes after they

learned how to use it. Senior consultants who already had job security were more willing to invest the time to explore and experiment with Notes.

Another group, the tax consultants who were located in the Washington, D.C. area, adopted the Notes program. The study suggests that they had significant incentive to show that they were visible and valuable within the firm, and using Notes was an opportunity to broadcast their visibility, to electronically publish their advice and make it available to many of the consultants around the firm, showing that the Washington office was not just overhead but an important part of the firm. Orlikowski's conclusion is that organizational incentive systems need to be taken into account when adopting information systems.

Davenport (1997c) documents how another large consulting firm (Ernst and Young) successfully adopted a Notes program. They created a mini organization (the Center for Business Knowledge) that organized Ernst and Young's consultants' into specific areas. This organization was staffed with consultants from other offices, who were given 6-month assignments to play a special role as "knowledge networkers." By 1997, they had developed 22 cross-office networks of consultants with expertise in certain industries and technology sectors. Each consultant network was assigned a half-time person who codified the Notes databases, organized the insights from different projects, prompted line consultants to add their own insights, edited and pruned the project's discussion and document databases. For some units they developed "Power Packs" in Notes, an earmarked and filtered set of on line materials and templates. These knowledge networkers came to understand consultants' needs and topics very well. Because the knowledge networkers were on short-term assignments, they were expected to use this new expertise to advance their careers when they returned to their consulting positions.

Taken together, these studies suggest that it is important to pay attention to the social context in which people use information technology, as well as the particular incentive systems for using, organizing, and sharing information in different work groups and work roles. The two different groups in Alpha Consulting and Ernst and Young had different incentives to share information about their know-how, and their respective outcomes were different. But another dimension that is central in the second case is the presence of a group that facilitates the learning process. It is notable that this group came from the very consultant group for whom the program was designed. They were able to bring field expertise to bear, and were able to build ongoing relationships in the field to prompt users to contribute. They became familiar with the dilemmas and challenges in the field and were able to guide the users to various resources in the program.

The above studies reflect a common assumption in much of the literature, that the problem with adoption of these information technology systems is an issue of motivation. However, another study of knowledge transfer best practices offers a different conclusion and a different set of lessons. Szulanski (1996) studied the phenomena of "knowledge stickiness," the extent to which problematic situations are experienced during knowledge transfer. Most conventional wisdom proposes that stickiness of knowledge transfer is due

to motivational factors. Many cite barriers of jealousy, lack of incentives, lack of confidence, low priority, lack of buy-in, inclination to "reinvent the wheel," recipients' refusal to do exactly what they are told, resistance to change, lack of commitment, and turf protection. He found that the primary obstacles to knowledge transfer of best practices are: 1) lack of absorptive capacity, which refers to the ability of the recipient to identify, value, and apply new knowledge; 2) causal ambiguity, or the uncertainty regarding cause-effect relationships on the part of the knowledge recipient; and 3) arduous relationship between the source and recipient, which is described by the degree to which the relationship serves as a conduit for knowledge and the degree of communication and intimacy in the relationship between the source and the recipient. This contradicts the conventional wisdom that blames motivational factors as primary barriers to the transfer of knowledge. The implications of these findings are profound: if absorptive capacity, causal ambiguity, and arduous relationships are the major impediments to knowledge transfer, perhaps it is profitable to devote efforts to develop the learning capacities of organizational units, to foster closer relationships between units, and to understand more systematically the practices and learning readiness of organizational units.

V. Implications and Recommendations

The body of literature reviewed in this report indicates that organizational characteristics and issues have at least as much, and perhaps more, importance than information technology issues in knowledge transfer. A key first step in the design of a lessons learned system, then, is to specify the organization for which the system will be designed. This is especially critical in regard to defense acquisition organizations, which vary in many respects. One could design an acquisition lessons learned system for the entire DoD, for any of the services, for a major command such as Army Material Command, for a subordinate command such as Aviation and Missile Command, or for a local organization, such as a lab, test range, or engineering center. One could also design a lessons learned system within any of these organizations for a particular specialty or acquisition career field, such as contracting, cost estimation, or program management. Clearly, learning will occur in different ways among members of these various organizations according to whether their relationships are strongly or weakly tied, the organizations' interpretive contexts, and many other factors.

Some factors have received little or no attention by researchers of organizational learning and knowledge management. Much of the knowledge management literature relies on cases from private sector firms, and so unique aspects of public organizations may have been neglected. For example, private firms typically have clearer goals, such as market share and profitability, than public organizations. Indeed, the knowledge management systems for private firms are often "closed" and unavailable to outsiders so that the firms can protect their knowledge and learning to achieve a competitive edge. Public organizations, particularly large ones, have less clear-cut goals and perhaps even conflicting and competing goals among their constituent elements. Clearly, a level of competition exists within DoD among the services, among programs, and among depots, test centers, and smaller organizations (Kronenberg, 1990). It seems likely then that such

competition could adversely affect the nature and extent of participation in a lessons learned system that spanned several acquisition organizations. Conversely, competition might promote participation in a "closed" lessons learned system within an organization. Such effects could be manifested more widely in DoD's current policy drive to become more "business-like" in its operations.

Table 2 shows how organizations might vary in some significant factors that affect acquisition lessons learned system design. Design may be most problematic for a DoD-wide system. Because most DoD members have weak ties (i.e., distant, infrequent, or nonexistent relationships) and low interpretive context (e.g., due to dissimilar backgrounds), a system targeted toward sharing of explicit and codified versions of lessons learned would seem most appropriate. However, possibilities of competition among DoD organizations may inhibit participation in such a system. Members of an acquisition specialty or career field in DoD share a higher interpretive context, which signals greater potential for lessons sharing. To the extent members of the same field share a professional loyalty to their field over loyalty to their organizations, some of the deleterious effects of competition may be mitigated. Members of the services and of major commands have weak ties, though interpretive context in these organizations is certainly higher than that of DoD. Organizational competition may yet exist at these levels, particularly for scarce fiscal resources. Sharing of tacit and complex lessons would be, as expected, most effective in subordinate commands and local organizations.

Organization	Ties	Interpretive Context	Organizational Goals
DoD	Weak	Low	Ambiguous/conflicting
Career field across DoD (e.g., all systems engineers)	Weak	High	Ambiguous/conflicting
Service	Weak	Moderate	Possibly mixed
Major Command	Weak	Moderate	Possibly mixed
Subordinate Command	Moderate	Moderate	Clear
Local Organization	Strong	High	Clear

Table 2. Variations in Organizational Factors in Acquisition Lessons Learned System Design

Such variation suggests the benefits of a contingency approach in lessons learned system design. Effective knowledge transfer between members of the acquisition community will require substantial investment of time and resources in determining what kind of knowledge is appropriate for different groups based on their relational history and context. Where members of an organization share strong ties, close proximity, and frequent interaction, complex and tacit knowledge will be easier to transfer. However, explicit knowledge may be redundant. If attempts are made to transfer explicit knowledge between strongly tied members, they might lose interest in the lessons learned system. Thus, leaders of smaller organizations should emphasize strong ties among members, a high interpretive context, and clear goals in order to maintain an environment that

facilitates sharing of complex and tacit lessons among members of a true community of practice.

Such communities of practice are probably not feasible in larger organizations where members are weakly tied and interpretive context is low. In such organizations, members are more likely to search for novel information in explicit and codified lessons. Thus, leaders of larger organizations should focus their efforts on eliminating barriers to and encouraging members' participation in systems that target such lessons. The Davenport study's findings may be especially significant in this regard. Leaders of larger acquisition organizations should consider assigning temporary duty to "knowledge networkers," who would work to actively seek input and stories from members, to map out relevant needs, to encourage inquiry, and to make connections between relevant parties. These knowledge networkers would engage in ongoing action research, creating emergent categories of practitioners' experiences and fostering connections between potential collaborators. Holtshouse (1998) says that one area of priority is to research the flow between knowledge seekers and knowledge providers in order to maximize the impact of knowledge. The system must continually learn the usage and communication patterns of both seekers and providers by looking at work practice profiles of individuals and communities.

VI. Conclusion

Acquisition professionals often find themselves creating novel solutions to unforeseen and unprecedented problems. Innovations that lead to successful acquisition outcomes are probably improvised. In many cases, therefore, the knowledge that would be most useful in enhancing learning within the acquisition community is the complex, tacit knowledge that resists codification and is difficult to verbalize. It is important in designing a lessons learned program to distinguish between the need for tacit, complex knowledge and explicit, codified knowledge.

Transferring complex knowledge and sharing insights is more than a matter of passing on information. Rather, the transfer of complex knowledge in the acquisition community is a matter of sense making. It involves telling stories about the actual practices and concrete situations that acquisition professionals grapple with. Informal story telling best occurs through social collaboration and dialogue, where reciprocal exchanges can occur. This will be a challenge if the only medium for knowledge transfer is through a technology-driven data repository. All of the studies of knowledge transfer claim that technology is an enabling factor, but no panacea, that leadership must create an environment that supports and enhances the sharing of knowledge.

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